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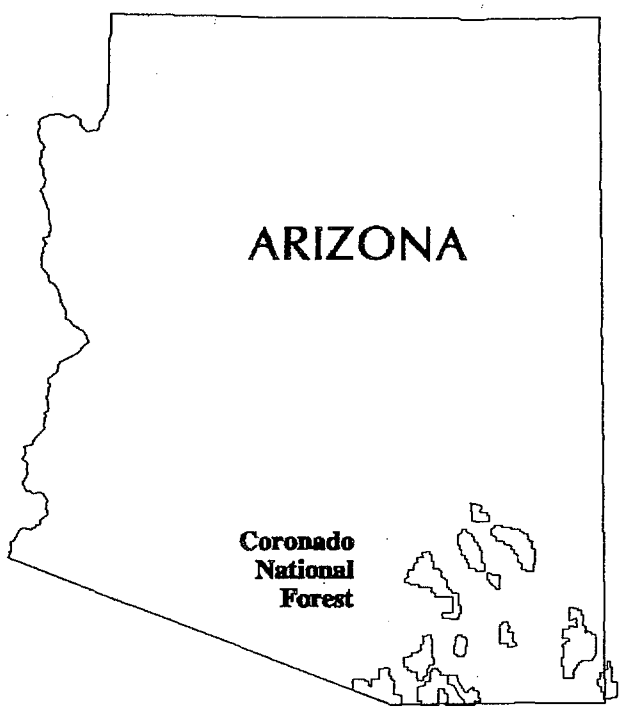
MINERAL APPRAISAL OF CORONADO NATIONAL FOREST, PART 15
Executive Summary



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

MINERAL APPRAISAL OF CORONADO NATIONAL FOREST, ARIZONA
PART 15

EXECUTIVE SUMMARY

by

Mark L. Chatman

MLA 23-94
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Intermountain Field Operations Center
Denver, Colorado

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16. Abstract (Limit: 200 words)

Staff from the U.S. Bureau of Mines (USBM) have completed a forest-wide mineral resource assessment for both metallic and non-metallic mineral commodities and an inventory of more than 1,100 mine and prospect groups in Coronado National Forest, southeastern Arizona. Field investigations, which included mapping of mine sites and collection of about 4,500 rock-chip geochemical samples from mineralized zones, were undertaken between the fall of 1988 and the spring of 1992. Assessment of the field data and publishing of the resultant 14 resource assessment/mine inventory reports (one for each Management Unit of the Forest and one forest-wide report addressing industrial minerals) were completed between the fall of 1991 and the summer of 1994. This report is a synopsis of all that work, and focuses on sites and commodities in the National Forest that are most likely to be targets of future mineral exploration and development. Much detailed economic analysis, historical background, and all mine maps and assay data are omitted from this executive summary. For sites at which more detail is desired, the individual mineral resource assessment/mine inventory report can be acquired from USBM, Intermountain Field Operations Center, P.O. Box 25086, Denver, CO 80225-0086.

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PREFACE

A January 1987 Interagency Agreement between the U.S. Bureau of Mines, U.S. Geological Survey, and the U.S. Forest Service describes the purpose, authority, and program operation for the forest-wide studies. The program is intended to assist the Forest Service in incorporating mineral resource data in forest plans as specified by the National Forest Management Act (1976) and Title 36, Chapter 2, Part 219, Code of Federal Regulations, and to augment the Bureau's mineral resource data base so that it can analyze and make available minerals information as required by the National Materials and Minerals Policy, Research and Development Act (1980). This report is based upon available information, extensive field investigations to verify or collect additional information, and contacts with mine operators and prospectors active on lands administered by the Coronado National Forest.

This open-file report summarizes the results of a U.S. Bureau of Mines forest-wide study. The report is preliminary and has not been edited or reviewed for conformity with the U.S. Bureau of Mines editorial standards. This study was conducted by personnel from the Resource Evaluation Branch, Intermountain Field Operations Center, P.O. Box 25086, Building 20, Denver Federal Center, Denver, CO 80225-0086.

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

acre(s)	ac
cubic yard(s)	yd^3
day	d
degree(s)	°
dollar(s) (U.S.)	$
foot (feet)	ft
inch(es)	in.
long tons(s) (2,240 lb)	lt
mile(s)	mi
percent	%
pound(s)	lb
short ton(s) (2,000 lb)	st
short ton(s) per day	st/d
short tons(s) per year	st/y
short ton unit(s) (20 lb)	stu
square mile(s)	mi^2
troy ounce(s)	oz
troy ounce(s) per short ton	oz/st
year	y

USE OF CHEMICAL SYMBOLS TO ABBREVIATE NAMES OF ELEMENTS

Use in text with concentration amounts implies the elemental form of that material; e.g., 0.05% Cu represents five hundredths of one percent copper in elemental form, not as copper carbonate or oxide.

Cu	copper
Au	gold
Ag	silver
Mo	molybdenum
Pb	lead
Zn	zinc

MINERAL APPRAISAL OF CORONADO NATIONAL FOREST, ARIZONA, PART 15
EXECUTIVE SUMMARY

by
Mark L. Chatman[1]

SUMMARY OF SIGNIFICANT FINDINGS

* Favorable geologic environments in Coronado National Forest have been mined in the past for large quantities of base-and-precious metals; one metal mine is currently (1994) active.

* In the foreseeable future, most major mineral exploration and development will be concentrated in the western part of the Forest, near the growing Nogales-Tucson, AZ, urban corridor.

* Future large-scale mining is most likely to ensue in the northern Santa Rita Mountains, south of Tucson, AZ, at a group of near-surface copper-porphyry deposits with over 400 million short tons of copper resources.

* Shallow, low-grade, refractory gold deposits, west of Nogales, AZ, have high potential for future development. Gold grades are nearly sufficient to support mining under current gold prices, but known tonnages are insufficient, based on sparse subsurface exploration. Geologic indicators suggest additional tonnage may be present but as yet undiscovered.

* Sporadic future exploration of deep copper-porphyry deposits in the Patagonia Mountains, northeast of Nogales, AZ, is possible, but the possibility of mining them in the foreseeable future is diminished because of deep burial of the combined several hundred million short tons of copper resources.

* Air-quality standards in Pima County, which increasingly have become more stringent, may eventually force development of stone and aggregate sources from more distant localities, such as Cochise County. If so, aggregate, limestone, marble, decorative stone, rip-rap, and gypsum sources from several localities in the National Forest may experience prospecting and development.

* Exploration for undiscovered copper-porphyry deposits in the northern part of the Santa Catalina Mountains, northeast of Tucson, appears to be warranted, based on limited geologic data.

[1] Geologist, Resource Evaluation Branch, Intermountain Field Operations Center, Denver, CO.

INTRODUCTION

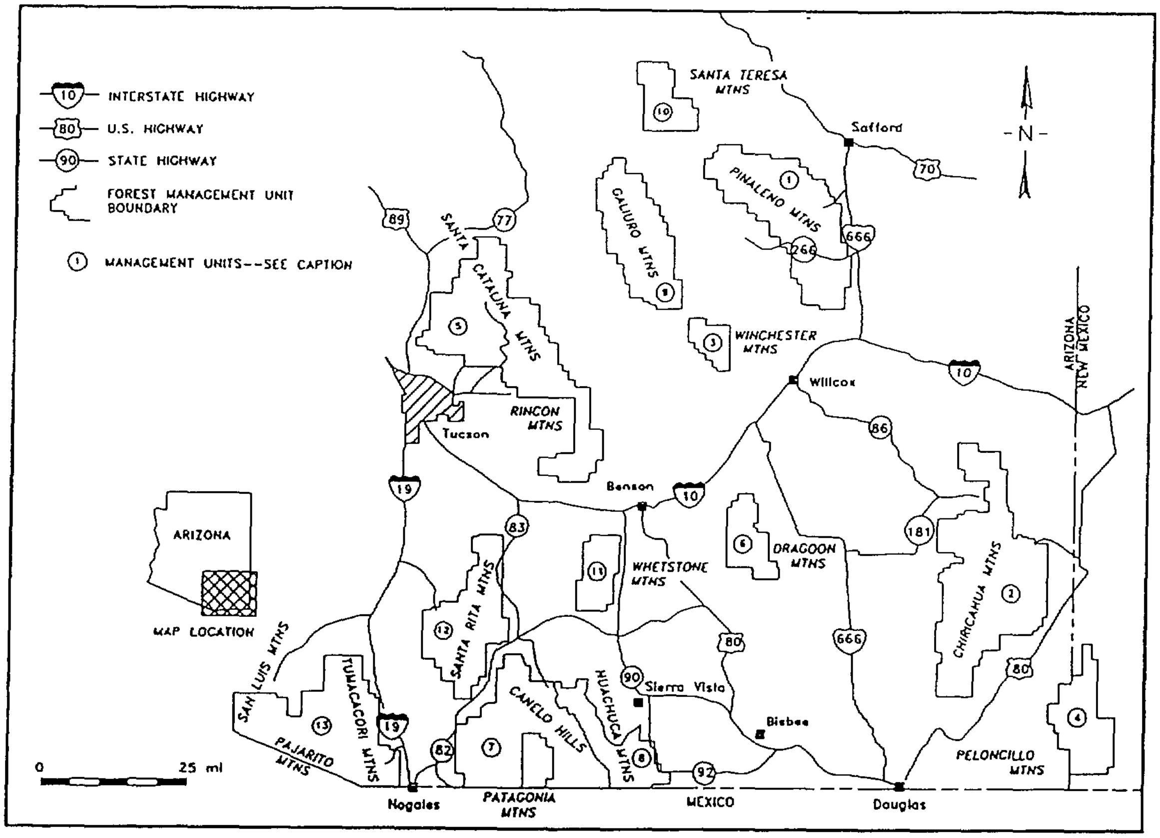
Coronado National Forest is comprised of approximately 1.85 million ac, mainly in Santa Cruz, Cochise, Graham, and Pima Counties, AZ; smaller parts of this non-contiguous National Forest (see fig. 1) are in Pinal County, AZ, and Hidalgo County, NM. The terrain is mostly mountainous and typical of the Basin and Range physiographic province. The lands are utilized in quite variant ways, including a ski resort, recreational lakes and reservoirs, grazing, wilderness, natural areas, scientific areas ranging from rare biological species preserves to astronomical observatories, public utility areas, and mining.

Mineral deposits formed in Coronado National Forest largely as a result of the major earth-crust deformation and igneous rock intrusion which took place during the Tertiary age, and particularly during Laramide time, although regional-scale structures and deformational trends that developed as long ago as Precambrian time influenced mineral deposit emplacement. Mineral production dates from the late 1600's to current operations, but the major mining eras were: the 1880's, the early 1900's to about the mid 1920's, and the 1940's to 1950's. Historical operations were primarily to develop base- and precious-metal veins, replacement zones, and skarns, all emplaced during intrusion of plutons and batholiths that accompanied mountain building. The majority of mining operations, historically, were underground and accessed by shafts or adits. Many shaft operations are inaccessible and some of the largest sites have already been reclaimed.

There are very few currently (1994) operating mines. The main active (1994) mines are an underground copper-silver skarn in the Santa Catalina Mountains and an open-pit operation for high-brightness marble products in the Santa Rita Mountains. Exploration is focused on four copper-porphyry deposits, which are being considered for open-pit development. Three are in the northern Santa Rita Mountains and one is in the Patagonia Mountains. There are small-scale active operations: two for aggregate and one for opal (Tumacacori and Atascosa Mountains).

Staff from the U.S. Bureau of Mines (USBM) have completed a forest-wide mineral resource assessment for both metallic and non-metallic mineral commodities and an inventory of more than 1,100 mine and prospect groups in Coronado National Forest. Field investigations, which included mapping of mine sites and collection of about 4,500 rock-chip geochemical samples from mineralized zones, were undertaken between the fall of 1988 and the spring of 1992. Assessment of the field data and publishing of the resultant 14 resource assessment/mine inventory reports (one for each Management Unit[2] and one forest-wide report addressing industrial minerals) were completed between the fall of 1991 and the summer of 1994. This report is a synopsis of all that work, and focuses on sites and

[2] Essentially each separate major mountain range in the National Forest.



Location of Management Units and listing of USBM reports that resulted from this project:

1. Pinaleno-Greasewood Mountains (USBM report MLA 8-93)
2. Chiricahua-Pedregosa Mountains (USBM report MLA 12-93)
3. Winchester Mountains (USBM report MLA 10-93)
4. Peloncillo Mountains (USBM report MLA 18-93)
5. Santa Catalina-Rincon Mountains (USBM report in press)
6. Dragoon Mountains (USBM report MLA 30-93)
7. Patagonia Mountains-Canelo Hills Unit (USBM report in press)
8. Huachuca Mountains Unit (USBM report MLA 1-94)
9. Galiuro Mountains (USBM report MLA 21-93)
10. Santa Teresa Mountains (USBM report MLA 26-93)
11. Whetstone Mountains (USBM report MLA 2-94)
12. Santa Rita Mountains (USBM report MLA 11-94, in press)
13. Atascosa-Pajarito-San Luis-Tumacacori Mountains (USBM report in press)

Industrial Minerals, forest-wide assessment (USBM report MLA 10-94)

Figure 1.--Location map, Coronado National Forest.

commodities in the National Forest that are most likely to be targets of future mineral exploration and development. Much detailed economic analysis, historical background, and all mine maps and assay data are omitted from this executive summary. For sites at which more detail is desired, the individual mineral resource assessment/mine inventory report can be acquired from USBM, Intermountain Field Operations Center, P.O. Box 25086, Denver, CO 80225-0086.

Each National Forest Management Unit (fig. 1) is summarized in the following sections with regard to possible future mineral exploration or development. Data were derived from mapping, geologic and economic modeling, and literature. USBM economic analysis (unless noted otherwise) was conducted using the PREVAL mine and economic modeling software package [methodologies described in Smith (1992)].

MINERALS IN THE NATIONAL FOREST MANAGEMENT UNITS

Atascosa-Pajarito-San Luis-Tumacacori Mountains Unit

A major northwest-trending fracture zone dissects the Management Unit for 27 mi; all major mineral deposits and mining districts are along this trend (USBM, 1994a, fig. 2). An igneous intrusive metallizing agent, suspected to be the source of most of the metal deposits, has not been found. Composite production is about 0.9 million st of metallic mineral ores; nearly all (97%) was mined from the base- and precious-metal sulfide vein deposit at the Montana Mine. Deposits hosted in quartz-sulfide veins, sulfide veins, auriferous, oxidized, vein-like breccias, and massive, flat-lying, refractory, silica zones account for the remainder of the past metal production. The latter are still the target of modern day exploration efforts. Small quantities of opal are produced from one deposit area and relatively small quantities of sand and gravel are currently mined from two sites.

Metallic minerals

Most significant in terms of possible future mineral exploration and development are gold deposits of the Oro Blanco mining district, hosted in massive, flat, refractory, silica zones, which may be hot-spring type deposits. They are low-grade (0.02 oz Au/st to 0.07 oz Au/st), shallow, and subeconomic at the mid-1994 gold price (a $387/oz price for gold). Only modest tonnages (0.4 million st to 1 million st) have been delineated in limited drilling programs conducted by industry. The hypothesized hot-spring genesis is economically significant. Also of hot-spring origin are micron-gold, disseminated deposits in Nevada and New Mexico, which have provided a major economic impact on the U.S. mining industry since the 1980's. Deposits in this Management Unit are hosted in acidic volcanic rocks and exhibit strong silicification attendant with gold mineralization. (See USBM, 1994a, p. 6-9.)

Margarita Mine (pl. 1, site 1), the best delineated of the flat, silica-zone gold deposits, contains 0.44 million st of 0.072 oz Au/st in a high-grade zone, and 0.52 million st of 0.046 oz Au/st, overall. Experimental recovery of gold at the mill is high (>90%). USBM modeling suggests a negative NPV[3] of -$18.4 million over the mine life. Mining the entire deposit, including the lower-grade material, simply detracts further from the economics. Low deposit tonnage and the current price of gold are major negative economic factors, as are capital requirements. At the current price of gold, the deposit would be a break-even economic venture if approximately 32.5 million st of 0.072 oz Au/st were discovered (USBM, 1994a, p. 9-10).

The White Gold/West claims encompass three flat, silica-zone gold deposits (pl. 1, sites 2-4), 16 less-well-delineated prospects, and two gold geochemical anomalies (pl. 1, sites 5-22). The Central zone prospect (pl. 1, site 3) contains 1 million st of 0.033 oz Au/st and 0.4 million st of 0.050 oz Au/st; industry data are not available for the other two delineated deposits (sites 2, 4, pl. 1). More tons of higher-grade gold are required for this area to be economic for development. Exploration at the other 16 gold prospects and two geochemical anomalies, about which little data are available, may delineate the needed additional tonnage. One of the 16 prospects, known as the Pedro prospect (pl. 1, site 17) could possibly contain 1 million st or more of auriferous rock, but grades delineated to date are low (0.05 oz Au/st, maximum) (USBM, 1994a, p. 10-16).

Another 14 flat, auriferous, silica zones are in the south-central part of the Management Unit (pl. 1, sites 23-36). Included in this group are Old Glory Mine, Ragnaroc Mine, and Austerlitz Mine. Few data are known concerning tonnage and gold grade of the zones. Most previous work has focused on auriferous veining, a common geologic occurrence in the flat silica zones. Study of the veining is misrepresentative because the veins have elevated gold grades but much lower tonnages than the flat, predominantly massive, silica zones (USBM, 1994a, p. 11-16).

Future prospecting for gold at some of these sites should be expected. A jump in the price of gold to a recent yearly average high ($438/oz, experienced in 1988) would spur an increase in activity.

USBM modeling of the auriferous breccia zones (not shown on pl. 1), which are low-tonnage, numerous, oxidized, and contain free gold, suggest that no deposit of this type has the combination of tonnage and grade to be economically developed, though some of the lower-angle deposits (45° of dip or less) may be more economical to develop in the future if technological improvements in mining of thin, low-angle veins continue (described in LaFlamme and others, 1994). Auriferous quartz-sulfide veins are considered even more

[3] NPV is "net present value", calculated at a 15% ROR (rate of return).

problematic due to the beneficiation costs required, and are not considered likely to see future exploration (USBM, 1994a, p. 17-20).

Non-metallic minerals

Rock products are produced currently (as of 1992) from the Clarke pit and another pit in Walker Canyon (pl. 1, sites 37-38). Products include 21,500 yd^3, annually, of construction sand and gravel, used to supply the Nogales, AZ, area. Clarke pit, site of most of the production, is on private land encompassed by the Management Unit. Clarke pit was put into operation in 1989 and may be reaching the end of its reserve base, as delineated as of 1992. Prior to mining, this deposit contained approximately 100,000 yd^3, worth approximately $0.5 million[4]. Twelve other areas identified by USBM in which sand and gravel deposits may be delineated are shown on pl. 1 (sites 39-50). (See USBM, 1994a, p. 25-27, p. A27.) Neither quantification nor qualification data are available to characterize these sites.

Opal at the Jay-R Mine or Scorpio claims (pl. 1, site 51) amounts to approximately 29,000 st of opal in 11.5 million st of rock, to a depth of 200 ft. Total production is estimated at less than 5,000 lb valued at slightly less than $2,000. Blasting, removal of rock with a bulldozer or backhoe, and hand-cobbing to reveal the opal is apparently the mining method employed. The operation will likely continue. No large, high-tonnage operation is anticipated (USBM, 1994a, p. 27-28).

Santa Rita Mountains Unit

Intrusions of granitic rocks emplaced the varied mineral deposits, most important of which have been skarn and other contact metamorphic deposits that formed over the Helvetia copper-porphyry deposit and hydrothermal system. Those types of deposits account for 86% of the composite past production of about 0.49 million st of ore. Small deposits of lead, zinc, silver, copper, and gold in quartz veins and fault zones account for most of the remaining past production. There is no mining of metallic mineral deposits in 1994, but the Greaterville placers and the Helvetia copper-porphyry deposit continue to undergo development work. A deposit of marble is currently being quarried for several uses.

Metallic minerals

Three copper-porphyry deposits (pl. 1, sites 52-54), collectively called the "Helvetia deposit", are on a mineral patent block currently undergoing development by ASARCO, Inc. The three sites are known individually as the Rosemont, Broadtop Butte, and Copper World.

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[4] Actual revenues achieved through this operation are not known. This approximation of value was made by considering the total time of production, production rate, the average price for sand and gravel in the region of $3.30/st (Phillips, 1992, p. 33), and assuming a density of 2,920 lb/yd^3 for the gravel, and estimating the total production over the mine life.

A fourth copper-porphyry of the Helvetia group, Peach-Elgin, is 1 mi west of the Management Unit (pl. 1, site 55). The copper porphyries have been known since the 1950's but have not been mined. They would probably be mined as a group, via open-pit mining, with both heap-leaching and conventional flotation methods, depending on the various ore types. The Rosemont copper-porphyry deposit alone contains 410 million st of sulfide ore and 90 million st of oxide ore, at grades of approximately 0.6% Cu, 0.019% Mo, and substantial Ag. Broadtop Butte deposit contains a 9 million st resource comprised of oxides and sulfides; Peach-Elgin deposit contains a 24 million st oxide-and-sulfide resource. Copper and molybdenum grades of those two deposits are comparable to the Rosemont deposit. No data are known about the Copper World deposit.

USBM mine modeling and economic analysis, using CES[5] and other cost data, estimate a 20-year mine life for an open-pit operation, centered on the Rosemont copper-porphyry sulfide ore, supplemented by concurrent production from the other three copper-porphyry deposits. Collectively, 20.5 million st would be mined per year with an average stripping ratio of three tons of waste to one ton of ore. A conventional sulfide flotation plant with a molybdenum recovery circuit would be utilized. Copper oxide ore would be recovered by heap leaching and SX-EW[6]. Infrastructure development would include construction of a 4.5-mi-long access road from the mine to State Highway 83 and utility lines to the mine and mill sites. Traffic on Highway 83 would increase as 1,060 st/d of copper concentrates would be shipped north via truck to a rail line. About 30 truck loads per day would be shipped (35 st per load). Estimated capital costs for the mine and mill would be about $490 million (all costs in 1994 dollars). Ore could be mined and milled for an estimated $6.43/st or $0.61 per lb Cu. Cathode copper from SX-EW could be produced for about $0.27/lb. At this level of capital and operating cost, and a copper price of $0.92/lb, a 15% ROR[7] could be realized over the life of the property. An 11% ROR could be realized with copper selling for $0.81/lb. Waste disposal would require about 2,000 ac over the mine life for the settling of 20.4 million st per year of flotation mill tailings. No plan was developed by USBM to determine how much of this material would be ultimately stored on the National Forest surface. (See USBM, 1994b, p. 8-12.)

Undiscovered copper-porphyry deposits may exist in an area delineated by Ludington (1984) (pl. 1, site 56). However, the coincident location of the Madera Canyon recreational

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[5] U.S. Bureau of Mines Cost Estimating System (version 2.0), an economic modeling software package for mineral deposits.

[6] Solvent extraction-electrowinning.

[7] ROR is "rate of return".

area and the Mount Wrightson Wilderness will probably discourage exploration (USBM, 1994b, p. 12-13).

No quantitative assessments of base- and precious-metal quartz vein deposits were made. Placer gold deposits of the Greaterville mining district, mined in the past for 28,500 oz of gold and 6,000 oz of silver, were not sampled by USBM. Proposals to mine two parts of the placer deposits had been submitted by industry for Government consideration (as of 1992) (pl. 1, sites 57-58); no mining is known to have resulted. The approximate location of five other areas of placer gravels in the district are shown on pl. 1 (sites 59-63).

Non-metallic minerals

The Specialty Minerals quarry (pl. 1, site 64) produces 100,000 st/y of marble and limestone from the Escabrosa Formation. The same intrusive igneous events that formed the copper-porphyry deposits discussed above also metamorphosed Escabrosa Formation carbonate rocks into economic rock products. Assorted blends are made by Specialty Minerals from the rock to produce materials that are incorporated into products such as copper processing circuits, wallboard, marking chalk, and plastic and glass production materials. The mine product also is utilized as roofing gravel, decorative stone, landscaping material, swimming pool plaster sand, livestock feed supplement, and functional filler-extenders. The high-brightness characteristic of part of the marble results in a higher unit value than typical marble deposits. The company plans for a 75-year mine life and for production rate increases up to 200,000 st/y. No overall valuation of the deposit was made by USBM. (See USBM, 1994b, p. 17-19.) The proximity of the quarry to the region's scenic vistas has led to some unique efforts in mining. One example is covering scars from an access road to the site with different colored rock so that the scar is camouflaged from views along the Interstate Highway. Nevertheless, the natural outcrop of the high-brightness marble deposit, which is all most people can observe from a distance, is often blamed for being a mining scar on the landscape, when in actuality, it would exist in identical form had mining never occurred. Another area of Escabrosa Formation limestone (pl. 1, site 65) that may have qualities comparable to the Specialty Minerals deposit was not evaluated or sampled.

Patagonia Mountains-Canelo Hills Unit

Known mineral deposits, confined to the Patagonia Mountains part of this Management Unit, are primarily of the base- and precious-metal type and formed due to intrusion of the Patagonia batholith into a considerable thickness of older rock. Past mine production, about 2.0 to 2.1 million st of ore, was from veins and fractures. Four mine groups, the Flux, Mowry, Trench, and Three R, account for about 70% of this production total. In addition, mining of about 20,000 lt of manganese ore, 230 st of tungsten concentrates, and 35 oz of placer gold has been documented (Chatman, 1994a, p. A1-A139).

Metallic minerals

Five subeconomic copper-porphyry and breccia-pipe deposits, most with byproduct quantities of molybdenum, are known and there are four other target sites where undiscovered copper porphyries may be found through additional exploration drilling. A large increase in the price of copper, heretofore unseen and not expected, could make underground development of the larger deposits more economically viable. A more likely scenario in the near future is simply exploration drilling to improve delineation of the known deposits (Chatman, 1994a, p. 8-28).

Red Mountain copper-porphyry deposit (pl. 1, site 66), with 250 million st of 0.72% Cu (hypogene, sulfide) at depths of 3,000 ft to 5,000 ft, has a high copper grade. However, depth to deposit is a major economic detriment that precludes development by traditional open-pit mining and demands more costly, uneconomical, underground mining methods. The incompletely delineated Ventura copper-porphyry deposit (pl. 1, site 67) contains unquantified tonnages of 0.2% Cu to 0.4% Cu (hypogene, sulfide) at depths of 600 ft to 1,100 ft and 0.3% Cu mineralization to depths of 2,000 ft. The sought-after, but as yet unfound hydrothermal alteration core of this deposit, which would be expected to contain higher copper grades, is probably deeper, at depths comparable to the Red Mountain deposit. These depths and known grades lead to a projection that the deposit cannot be mined economically by open-pit methods. Very few data are available concerning the Three R copper-porphyry deposit (pl. 1, site 68), where sulfide copper occurs at a depth of 3,000 ft; grade and tonnage are not known by USBM. It is likely too deep for open-pit development. Future improvement in the *in-situ* leaching of copper from *sulfide* minerals, may improve the economic viability of the Red Mountain, Ventura, and Three R deposits (current *in-situ* technologies are substantially more effective for recovery of copper from *oxide* minerals than from sulfide minerals).

Four Metals Hill (Red Hill) copper-porphyry deposit (pl.1 , site 69) is shallow, but is also small and low-grade, based on data available to USBM, containing 5 million st of 0.61% Cu (supergene, sulfide) at depths as shallow as 50 ft and 8.6 million st of 0.47% Cu (hypogene, sulfide) between depths of about 100 ft and 900 ft. Small deposit size apparently precludes economic development by either open-pit or underground methods, but exploration of alteration areas to the north and east of the deposit could find additional resources (the known deposit may have been dismembered by faulting). The Ventura copper and molybdenum breccia-pipe deposit (pl. 1, site 74), with 3.6 million st of 0.25% Cu and 0.4% Mo in a steeply inclined pipe located between the surface and a depth of 2,600 ft, is not economical to mine by underground methods due to the low grade and low tonnage. The Ventura breccia pipe, under foreseeable conditions, would be developed only in conjunction with mining of the underlying Ventura copper-porphyry deposit.

Areas where other copper-porphyry deposits may be discovered include Meadow Valley, Red Bank Well and Jensen Camp, Kunde Mountain, and the area beneath the Washington Camp-Duquesne Camp base- and precious-metal skarn deposits (pl. 1, sites 70-73).

Possible sources of manganese (pl. 1, sites 75-88) and aluminum (occurring as alunite) (pl. 1, sites 89-93) are significant because the U.S. is totally dependent on foreign sources for both metals. However, these are very low-grade deposits which could not be mined economically; neither metal would be the target of future mineral development except in the event of a severe import supply disruption. The Hardshell manganese deposit, a resource with 15% MnO_2 and 5 oz Ag/st (pl. 1, site 75) is the best of the known manganese deposits. Alunite sources are not well delineated, and any emergency development of the metal in the U.S. would likely focus on better deposits in other regions of the country (Chatman, 1994a, p. 28-45, 47-50). Placer gold occurrences (pl. 1, sites 94-97), not sampled by USBM, are unlikely to experience future prospecting, primarily due to lack of water for placering. Gold concentration in the placers is probably low, based on the very limited past production, and the fact that known lode gold sources in the area (original sources of placer gold) have anomalously low gold concentrations (Chatman, 1994a, p. 45-47).

Non-metallic minerals

Gravel sources have been utilized to build Parker Dam and National Forest roads. Individual sites of production were not examined or tabulated. The lower part of the Parker Canyon drainage channel, for about 4.5 mi northeast of the U.S.-Mexico border (pl. 1, site 98), is likely the largest accumulation of alluvial material.

Huachuca Mountains Unit

Carbonate rocks have been metallized where enveloped by a large pluton of intrusive rock or by volcanic rocks and contain occurrences of copper, gold, lead, silver, zinc, manganese, and tungsten. Tertiary-age quartz veins in the pluton carry gold values (Tuftin and Armstrong, 1994, p. 3, 5). Past mineral production is not well documented. The commodities of which the largest quantities were mined are silver (60,000 oz), tungsten (about 16,000 stu), copper (about 0.3 million lb), lead (about 0.5 million lb), and gold (about 200 oz lode and about 200 oz placer) (Tuftin and Armstrong, 1994, p. 5-15).

Metallic minerals

No resources are estimated as a result of this USBM work, a function largely of the inaccessibility of underground mine workings (preventing data collection) and paucity of literature (Tuftin and Armstrong, 1994, p. 1).

Non-metallic minerals

Tako #9 claim (pl. 1, site 99), with an estimated 20,000 st of silica that may have application as a smelter flux, is considered unlikely as a future development site because of low tonnage and the fact that other silica flux sources, including some inside the National Forest, are located closer to the operating copper smelters in the region (Tuftin and Armstrong, 1994, p. 110). Precious metals content is demanded by operators of smelters in the region in order to consider silica deposits for use as flux; amounts of 0.2 oz Au/st and 0.5 oz Ag/st are considered minimums (as of 1993) (Chatman, 1994b, p. 16). Testing of Tako #9 silica demonstrates its precious metals content is above or near these minimums, averaging 0.18 oz Au/st and 0.95 oz Ag/st.

Whetstone Mountains Unit

Sedimentary rocks were altered into metallized skarns, where enveloped by a young granitic stock; this stock contains weakly delineated copper resources. A much older intrusive rock is host to a variety of vein-type mineral occurrences, including fluorite, tungsten, uranium, and silica flux. Gypsum beds are present within some of the sedimentary rocks. Past mine production has been small: 20,000 st fluorspar; an estimated 300,000 st of silica flux; an estimated 5,000 st to 10,000 st of copper-lead ore with byproduct silver and gold; negligible amounts of tungsten concentrates and uraninite (Chatman, 1994b, p. 2, 4-5, pl. 1).

Metallic minerals

Inferred, subeconomic resources at the Granite Peak stock copper deposit (pl. 1, site 100) are estimated by USBM to be 22 million st of 0.3% Cu (veinlet and disseminated, sulfide), based on limited subsurface data, consisting of drill data and assays, reported in DeRuyter (1979). Open-pit mining of the resource, to a depth of 900 ft, would not be economical due to low tonnage and low grade. The site continues to be of interest to private industry exploration efforts. Industry may have other, more complete data which would allow for a more favorable economic model of this site (Chatman, 1994b, p. 6-9). Future exploration and development of other metallic minerals is considered unlikely (Chatman, 1994b, p. 9-13, 17-21).

Non-metallic minerals

Ricketts Mine deposit (pl. 1, site 101) contains an estimated 8 million st of silica flux resources. Significant past use substantiates applicability of the rock as flux, but limited sampling suggests the silica is barren of precious metals. Further development as flux is therefore unlikely (Chatman, 1994b, p. 15-16). Gypsum occurs in at least two of the four areas underlain by the middle member of the Epitaph Formation (pl. 1, sites 104-107). Resources delineated at site 105 are low-tonnage (137,000 st), low-grade, have limited applications, and occur in terrain that is highly detrimental to mining of the bedded deposits. Future development is unlikely. No gypsum has been verified (as of 1992) at sites 104 and 107. Nearby, but outside of the Management Unit are three, much larger, higher-grade, and more readily minable gypsum deposits at the southern end of the Whetstone Mountains (pl. 1, sites 108-110) and two small, flat deposits to the northwest (pl. 1, sites 102-103) (Chatman, 1994b, p. 24-31). Known fluorite resources at the Lone Star Mine have been mined out. This is the only known vein of fluorite in the Management Unit (pl. 1, site 111). No exploration has been done to find vein continuity beyond the mined-out extent (Chatman, 1994b, p. 13-15).

Santa Catalina-Rincon Mountains Unit

Areas where sedimentary rocks have been altered to skarn or replacement zones account for all the economically significant past production: 0.86 million st of copper-silver-lead-zinc ore from which about 4,500 oz of gold were recovered. Ninety-nine percent of the production total came from just one mine, the Oracle Ridge property. Occurrences of sulfidic, gold- or silver-lead-zinc-bearing veins and faults, and scheelite veins also have been mined, with a composite production of 6,500 st. Some argentiferous silica flux, and some rock products (sand and gravel, and fill material) have been mined (USBM, 1994c, p. 4-7).

Metallic minerals

Oracle Ridge Mine copper-silver skarn deposit (pl. 1 , site 112), which is entirely within a mineral patent, is currently (1994) mined at a rate of 0.285 million st/y by Oracle Ridge Mining Partners. Ore, which contains an average of 2.33% Cu, 0.67 oz Ag/st and 0.011 oz Au/st is beneficiated on site in an 850 st/d single product flotation mill. A reserve is reported at 4 million st with a 1.5% Cu cutoff grade. USBM modeling of the mine and economics suggests that an optimum mine life is 13 years and that the property represents a $5.1 million NPV at a 15% ROR over that time. The deposit location, along the Geesaman fault zone, is related to its origin. An area along that same fault zone at which other skarn deposits may be found is locality 113 (pl. 1), but available data from this area do not encourage further exploration; narrow skarn widths and low overall tonnages are suggested (USBM, 1994c, p. 8-11).

A plan has been developed[8] to mine the Korn Kob calc-silicate skarn deposit (pl. 1, sites 114-115) for copper, by two open pits, one inside the Management Unit and one outside. Overall, the deposit contains 20 million st of 0.42% acid-soluble copper; 12 million to 14 million st of the total are within the Management Unit. Maximum depth to be mined from the two, simultaneously operated pits would be 600 ft. USBM modeling of the operation suggests a profitable, 16-year operation could be achieved at a mining rate of 3,000 st/d. Overburden would be dumped within the Management Unit. Mined ore would be processed by acid heap-leach methods; locations of two company-proposed leach pads are on pl. 1 (sites 116-117). The SX-EW mill, outside the Management Unit (pl. 1, site 118), would process the copper-bearing solution from the heap-leach operation into commodity-grade copper (USBM, 1994c, p. 9, 11-12). Skarns similar to the Korn Kob deposit occur in area 119 (pl. 1), but have not been mapped, precluding resource assessment.

Several geologic conditions similar to those at the San Manuel copper-porphyry deposit (pl. 1, site 120) have been identified nearby, over a large area of the Management Unit in the northeastern Santa Catalina Mountains (pl. 1, site 121). The geologic similarities (see USBM 1994c, p. 21-24) suggest that a copper-porphyry deposit or deposits could be concealed beneath this part of the Management Unit, but a search of the literature revealed no evidence that this area has been explored for possible large-scale copper-porphyry metal deposition. If there is any future exploration, the program might be designed around a San Manuel-type deposit model; San Manuel is a major deposit with approximately 500 million st of 0.8% Cu.

The small lode gold deposit (82,500 st) at the Southern Belle Mine and the Apache Girl prospect shear zone (pl. 1, sites 122-123), containing an estimated 0.28 oz Au/st, could be mined economically at the mid-1994 gold price of $387/oz if the reports of free-milling gold are correct. If the gold particle size is too small, or there is a large quantity of oxidized gold minerals in the deposit, more costly heap leaching would be required, forcing the property to be subeconomic. A mine life of three years is estimated by USBM modeling. Other resource evaluations have estimated this deposit to be between 618,800 st and 3 million st. USBM economic modeling suggests that the smaller tonnage, if correct, could be mined profitability over a 6-year mine life, if free-milling gold is present. The larger estimate, 3 million st, would support a profitable 8-year operation with either gold recovery method. All models assume 0.28 oz Au/st throughout. Uncertainties about the deposit size and ore mineralogy remain because USBM was not granted permission to evaluate this property, which is on a mineral

[8] Plan by Keystone Minerals, Inc., Tucson, AZ.

patent. A thorough testing of the recoverability of this gold would be a necessity prior to any mining of the site. (See USBM, 1994C, p. 9-10, 13-14.)

No resources are identified at the other metalliferous veins in the Management Unit, which include auriferous veins, tungsten veins, and silver-lead-zinc veins (USBM, 1994c, p. 15-19, 23-25).

Gold placers in the Management Unit were not mapped or sampled in the course of the USBM investigation. Key information regarding these deposits was obtained from literature. Placer sites in Canada del Oro (pl. 1, sites 124-128) are all outside of, and downstream from, the Management Unit. Gold production of as much as 1,000 oz has been reported from 1904 to 1949 (Wilson, 1961, p. 61). It is likely that much of this gold originated from veins within the Burney claims (pl. 1 , site 129). The segment of the Canada del Oro staked with the Burney claims (pl. 1, site 130) likely has gold placers as well. Sites previously placered in Southern Belle Canyon are approximated on pl. 1 (site 131). Evidence of placer mining is limited to the upper part of Southern Belle Canyon, where workings are less than 10 yd^3 each. Lower parts of Southern Belle and Bonito Canyons and intervening areas (pl. 1, site 132) have been mapped as Quaternary alluvium (Ludden, 1950, plate 1; Creasey, 1967, plate 1) and may contain placer gold. The sources of the placer gold are likely the 2-mi-long shear zone passing through the Southern Belle Mine and gold-bearing quartz veins in the northeastern part of the Oracle mining district. A segment of Alder Canyon adjacent to the Management Unit (pl. 1, site 133), has past production of 100 oz of placer gold (Wilson, 1961, p. 81; Keith, 1974, p. 35; Heylmun, 1989, p. 11); related placer gold deposition may be present in a nearby small (300 ft by 3,000 ft) area (pl. 1, site 134). Metallic deposits in the Marble Peak area, 3 mi away, may be the gold source in the Alder Canyon area.

A resource assessment cannot be made with the lack of data on these placers. The most recent work done in the area was a test placer operated in 1982, by Dave McGee, Little Hill Mines, Inc., on one of the Canada del Oro sites shown on pl. 1 (sites 124-128) (outside the Management Unit). A reported 230 oz of gold was recovered in that test, which was on placer gravels allegedly near 200-year-old placer sites of the Spaniards (Heylmun, 1989, p. 11). These data suggest that some lucrative gold zones may be found in Canada del Oro with additional prospecting. The clustering of the known sites outside the Management Unit boundary is not favorable for a gold-resource-on-public-lands scenario. Should the price of gold increase, mapping and sampling of the placer gravels may be warranted.

Non-metallic minerals

Gold Hill Mine (pl. 1; site 135) produced 60,000 st of silica flux as recently as 1991 and contains a reported 5 million st flux reserve with 0.5 oz Ag/st. The Hayden smelter, 45 mi distant, used the flux; sources closer to that smelter now (1994) present prohibitive economic competition. Further, precious metal content is apparently too low for current utilization of this rock as flux, based on limited USBM sampling.

Sites with possible resources of sand, gravel, and fill material (pl. 1, sites 136-145) are unlikely to be developed because of environmental concerns and land use that conflicts with mining. No qualitative data and few quantitative data are available. Fill material near the Mt. Lemmon Highway (pl. 1, site 141) will be mined out during current (1994) operations to improve the Mount Lemmon highway (Armstrong and Martin, 1994, p. 28).

Escabrosa Formation limestone (pl. 1, site 146) which "appears to be free of primary impurities", and other parts of the formation in the vicinity of Marble Peak which have been metamorphosed to marble (pl. 1, site 147) have yet to be evaluated for possible utilization. High-brightness marble deposits comparable to that of the Specialty Minerals deposit in the Santa Rita Mountains (see p. 8) may be discovered through exploration.

Galiuro Mountains Unit

Volcanic rocks cover the Management Unit; some, where weakly metallized along fractures, yielded a composite 537 st of copper-silver-gold ore. Older, possibly metallized rocks are concealed by these volcanic rocks (Brown, 1993a, p. 1, 5).

Metallic minerals

No resources or deposits are delineated as a result of the USBM study. However, the possibility of a concealed, metallized or metallizing granodiorite intrusion beneath the volcanic rock cover is of considerable importance, relative to the possibilities of future mineral prospecting. Unfortunately, the probabilities cannot be assessed without drilling or remote sensing work. Such work was not a part of this USBM study. The adjacent Copper Creek mining district contains breccia pipes and vein deposits from which copper, molybdenum, lead, silver, and small amounts of gold were mined. Over 11 million lb Cu, 4.1 million lb Mo, 3 million lb Pb, and 0.2 million oz silver were produced from these deposits. The mining district's host rocks undoubtedly extend into the Management Unit where they are concealed beneath volcanic rocks. Degree of metallization and location of concealed metalliferous deposits inside the Management Unit, if any, cannot be assessed but Creasey and others (1981, pl. 2) delineate an area of about 30 mi^2 that may be favorable for copper prospecting (pl. 1, site 148) (Brown, 1993a, p. 5-9).

Non-metallic minerals

The Deer Creek Mine (pl. 1, site 149), was producing fire agate and chalcedony (as of 1992) from an open-cut. No details of the operation, including production, are known by USBM. Operations of this type (precious and semi-precious quartzose stones) are typically small; no large-tonnage operation is anticipated, although continued production in the future is considered likely.

Santa Teresa Mountains Unit

Minor metallization related to breccia pipes and intrusive rocks in the adjacent Aravaipa mining district occurs as veins and replacements in limestone. The Aravaipa district contains lead-zinc-silver deposits with small amounts of gold and copper; 0.3 million st of ore was produced from the district, but only 135 st of that total was mined from within the Management Unit (Brown, 1993b, p. 5-8).

Metallic and non-metallic minerals

No deposits are delineated as result of USBM work and none are indicated in the literature.

Pinaleno-Greasewood Mountains Unit

Granitic rocks have been prospected for base and precious metals, mainly copper, and also for uranium and tungsten. Composite past production is 240 lb of tungsten oxide (Brown, 1993c, p. 5, pl. 1).

Metallic and non-metallic minerals

A swarm of northeast-trending dikes (quartz latite and monzonite) (pl. 1, site 150) is conjectured to be the possible surficial expression of a concealed, metallizing pluton west of the Management Unit (Davis, 1973). Some of the dikes were prospected, particularly around Lindsey Canyon (pl. 1, site 151); they reveal quartz veins with pyrite, copper oxides, and a few elevated gold concentrations (Brown, 1993c, p. 6-7, pl. 1, fig. 2). In the search for this hypothesized metallizing pluton, an area adjacent to the Management Unit was identified as a favorable exploration target for a copper-porphyry deposit (Swan and Chakarun, 1973); the most favorable target (pl. 1, site 152) is speculated to be the intersection of a shear zone and the dike swarm, at a depth of about 3,500 ft. It is not known by USBM if any drilling took place. Any copper-porphyry deposit that might be discovered probably would *not* underlie the Management Unit, but the possibility cannot be eliminated with available information. Importantly, the likely host site (the dike swarm-shear zone intersection) is the same Precambrian-age granitic rock that comprises the geology of most of the Management Unit; proximity of the target to the Management Unit boundary is also an important issue. (See Davis, 1973.) An increase in the price of copper in the future, or improvements in *in-situ* recovery of copper from sulfide minerals may spark renewed exploration. The hypothesized depth of the exploration target, over 3,000 ft, precludes open-pit mining of any discovery that might be made.

No non-metallic mineral deposits are delineated by this USBM work and none are indicated in the literature.

Winchester Mountains Unit

Volcanic rocks cover this Forest Unit. There are no mines or prospects. Nearly one-third of the acreage is state or privately owned surface.

Metallic and non-metallic minerals

The Management Unit may contain concealed gold- and silver-bearing vein and replacement deposits similar to those hosted by carbonate rocks in the Winchester mining district, about 1.5 mi south of the Management Unit boundary. The cover of volcanic rocks in the Management Unit precludes assessment of this possibility. This lack of data can be tempered with the fact that mineral production from the Winchester mining district was small; little more than 200 st was mined over the life of the district, which ended in 1949 (Armstrong and Brown, 1993, p. 5-7, 11, 14-15).

No non-metallic mineral deposits are delineated by this USBM work and none are indicated in the literature.

Dragoon Mountains Unit

The Stronghold batholith enveloped older sedimentary rocks and reacted with them to form metallic mineral deposits, particularly along fractures. Mining has been for zinc and copper, with byproduct silver, from calcic skarns; production was mainly from five mines, which totalled 80,000 st of ore. No other deposits in the range produced as much as 400 st ore. No single deposit in the range exceeds 40,000 st in size (reserves plus resources). Along the northern edge of the range, marble deposits were quarried for about 69,000 st. Most marble production was used as terrazzo and roofing granules (Chatman, 1993, p. 4-6).

Metallic minerals

Some prospecting of zinc-copper-silver skarn deposits has taken place nearly every year since mining ceased in the late 1950's; most activity has been in Middlemarch Canyon, due to pervasive copper concentrations and the potentially extensive overall length of the mineralization trend. Continued small-scale exploration in this area (pl. 1, site 153) should be expected in the future, but no large deposits are known and there is no geologic evidence available to USBM to suggest any mining will commence. The deposits are apparently too small to be economically mined. Gold content of the skarn-type deposits is far below economic levels, although small amounts have been recovered from smelting of the base metals. The skarn and fault zone at the Black Diamond Mine (pl. 1 , site 154) were prospected for gold as recently as 1992; USBM samples from the mine and outcrops of the fault zone prove the existence of gold, but at quantities far below ore grade. Industry drill data, not available to USBM, may reveal different gold concentrations. Two large mineral patents on the east slope of Mt. Glenn (pl. 1, site 155) are registered as gold placers. Access was not granted to USBM to evaluate these sites and no historical data or geologic data in literature was found to describe the sites or gold occurrences. (See Chatman, 1993, p. 5-6, 34-35, 40-41.)

Non-metallic minerals

Marble resources of 270,000 st are present (pl. 1, sites 156-159); they could be utilized mainly as landscaping boulders and as marble-chip ground cover. The material represents a net value of approximately $6.5 million, but it is not likely that the region's markets can absorb that quantity of product. The primary value of the rock is its color; several varieties of colors are available.

Limestone and dolomite, primarily of the Escabrosa Formation, are pervasive in an approximately 1 mi^2 area of the Management Unit (pl. 1, site 160); the rocks were not mapped or sampled for the purposes of this study. The rocks possibly have several low-unit-value applications. The dolomite and limestone could be used as crushed stone for fill material. The limestone may have additional applications as crushed stone for agregate, raw material for portland cement, and use as a sulfur-dioxide scrubber for power plant and smelter stack emissions. Only 2,000 st have been mined. The potential portland cement application of these rocks could have the greatest economic impact on the Management Unit, though no development is anticipated in the immediate future. Distance to markets is currently (1994) prohibitive. Increasingly stringent air quality standards in Pima County and public objection to the processing methodologies employed at the existing cement plant may drive producers out of the county. As the need for aggregate and cement will *not* diminish following such an event, Cochise County may experience development of new plants and new raw material sources to fill a void created in Pima County. If that event occurs, the deposits in the Management Unit may be developed (Chatman, 1993, p. 10-17).

Chiricahua-Pedregosa Mountains Unit

The Apache Pass fault zone (pl. 1, site 161) has been a conduit for metallizing solutions. Mineral deposits formed in limestone within the fault zone are comprised of lead-silver-zinc, or copper deposits in replacements and veins. Some gold has been recovered. Composite production is 28,000 st. Over 20,000 st of the production total came from the

Hilltop Mine (pl. 1, site 162), which yielded nearly 7 million lb Pb, over 1 million lb Zn, 57,000 lb Cu, and 75,000 oz Ag (Brown, 1993d, p. 1, 6-9).

Metallic minerals

The nature of metallization in the Apache Pass fault zone is sporadic, with poor surficial exposure. These characteristics prevented any estimation of mineral resources within the fault zone as a result of the USBM study, although this area, based on geologic inference, has been described by other workers as having a moderate to high potential for metalliferous deposits at depth (Brown, 1993d, p. 1-2). In 1993, a plan was submitted to the Forest Service by a prospector for re-opening the Hilltop Mine. No details of this effort are known by USBM.

In the late 1980's through 1990, Newmont Mining Co. explored the northeasternmost part of the Management Unit and adjacent lands to assess gold and gold indicator elements in jasperoid that occurs at and near the contact of volcanic rocks and limestone. A plan was formed to drill four exploratory holes inside the Management Unit so as to further assess this area. The plan resulted in sustained public opposition and Newmont Mining Co. withdrew its application for drilling permits. Most of the pertinent data are held confidential by the company. The general area of interest is site 163 (pl. 1) (Brown, 1993d, p. 34-35, 188). No further exploration efforts are anticipated due to U.S. Congressional legislation to remove the land from mineral entry.

Non-metallic minerals

El Tigre Mine (pl. 1, site 164) contains an estimated 0.3 million st to 8.9 million st of quartz vein material that can be used as a smelter flux. About 700 st to 800 st was mined in 1973 to 1974 for the Phelps-Dodge Reduction Works, Douglas, AZ (since dismantled); those shipments met the quantitative requirements of at least 85% silica and no more than 4.5% alumina. Gold content of the estimated resource is too low for current flux standards (as of 1992), having just 0.005 oz Au/st on average; silver content is approximately at the minimum concentration required by smelters, at 0.52 oz Ag/st. Future development of this flux resource is not considered likely (Brown, 1993d, p. 24-25).

Peloncillo Mountains Unit

A rhyolitic intrusive rock, associated with faulting, silicification, pyritization, and argillic alteration, was the target of gold and silver exploration. The Silver Tip Mine (pl. 1, site 165) is in this exploration area; no mine production is known (Armstrong, 1993, p. 3, 5-11).

Metallic and non-metallic minerals

USBM estimates that a fault zone in silicified rock exposed on one level at the Silver Tip Mine (pl. 1, site 165) contains 6,000 st with 0.01 oz Au/st, but future exploration or development are considered unlikely due to this low grade and negligible tonnage (Armstrong, 1993, p. 16). No non-metallic mineral deposits are delineated by this USBM work.

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Abbreviations used: USBM is "U. S. Bureau of Mines". ADMMR is "Arizona Dep. of Mines and Mineral Resources".

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GLOSSARY OF GEOLOGIC, MINING, AND SCIENTIFIC TERMS USED IN THIS REPORT

acid-soluble copper: copper that can be dissolved and leached from ore by contact with sulfuric acid; primarily refers to copper in the form of oxide minerals, in contrast with copper in the form of sulfide minerals.

alluvium: rock and rock particles deposited by water, such as flowing streams or intermittent streams; commonly sand and gravel, silt, and cobbles.

alteration/altered: non-specific; chemical change in rock as evidenced by influx of new elements or the formation of new minerals or the destruction of previously existing minerals; often used as an indication that process which formed or may have formed economic mineral deposits have operated in the locality.

alunite: a mineral that has been considered as a possible low-grade source of aluminum.

adit: an underground mine excavation that is largely horizontal and linear.

argentiferous: containing silver or silver-bearing minerals.

argillic alteration: specific variation of alteration/altered (see above); characterized by the formation of clay minerals from original mineral components of a rock (primarily feldspars).

auriferous: containing gold or gold-bearing minerals.

auriferous gravels: gold-bearing alluvial material, composed primarily of gravel-sized particles; a chief component of a gold placer.

base metal: any of the non-precious metals; primarily copper, lead, and zinc.

batholith: a large-scale intrusion of igneous rock (compare to definition of stock below).

breccias/breccia zones: referring to igneous or volcanic breccias and breccia zones; a coarse-grained clastic rock composed of angular broken rock fragments held together by a mineral cement (A.G.I., 1980); those of economic interest are typically the host of metallic mineral deposits.

breccia-pipe deposit: a mineral deposit, typically metallic, formed in a volcanic pipe, or the vertical conduit through the Earth's crust below a volcano through which magmatic materials have passed (A.G.I., 1980); in the National Forest, breccia-pipe deposits of interest are intimately associated with copper-porphyry hydrothermal alteration systems and contain amounts of copper and/or molybdenum that elicit economic interest.

byproduct: in reference to mineral commodities in mine products; those that cannot be economically recovered due to low concentration or commodity price but which are recovered in the process of recovering some other mineral commodity from the same mine product; typically a low-grade metal recovered in a smelting process designed to recover a primary metal commodity such as copper or gold.

calcic skarn: a skarn derived through the alteration of limestone, as contrasted with skarn derived from the components of dolomite.

calc-silicate: a group of minerals that are indicators of a metamorphic rock formed through metamorphism of impure limestone or dolomite (A.G.I., 1980).

carbonate rocks: sedimentary rocks, usually called limestone, with a chief component of the compound calcium carbonate (equivalent to the mineral calcite).

conventional flotation: a mineral beneficiation and recovery process applied to separate metallic sulfide minerals, such as chalcopyrite (copper), sphalerite (zinc), and galena (lead), from non-metallic gangue minerals that are not of economic interest.

copper oxide: a non-specific term to refer to a group of copper-bearing minerals in which the chief chemical bonds are with oxygen, rather than sulfur; copper minerals that are desired and amenable for processes such as heap-leaching and in-situ leaching, as opposed to copper minerals that require flotation and smelting for metal recovery.

copper-porphyry deposit: a type of copper deposit that is of major economic importance; formed deep in the Earth's crust through hydrothermal alteration (see below) related to volcanic (see below) processes; composed of concentric alteration "shells" which are chemical indicators of types and degrees of alteration and approximate locators of higher or lower grades of copper; the copper can be disseminated (see below), in veinlet zones (see below), associated with breccia pipes (see above), or in zones of supergene enrichment (see below), but most deposits contain some amounts of all four of these occurrence types.

deposit: in reference to mineral commodities, a natural occurrence of a useful mineral in sufficient extent and degree of concentration to invite exploitation (USBM, 1968).

disseminated: in reference to mineral commodities, dispersed through a geologic host rock, in contrast with a deposit that is concentrated in veins, breccias, faults, or other geologic structures; usually implies low grade.

faulting/fault: a *fracture zone* (see below) along the plane of which movement of rock or other geologic materials has occurred; faulting is the process, the fault is the physical zone.

fluorite: a calcium-based mineral that is a primary source of the element fluorine.

fluorspar: ore composed primarily of fluorite.

fracture zone: a region, usually planar, in which rocks and other geologic materials have been broken in response to stresses resulting from earth processes, such as crustal movement; appears to be linear with respect to the earth's surface.

free-milling gold: gold that can be recovered from a mine product by simply grinding or crushing the mine product and subjecting it to some sort of gravity-based separation method, such as washing with water, jigging, etc.; often the gold is largely or wholly in native form (pure gold) in order to allow this process to be feasible; a contrasting term to "gold that is in sulfide form".

free gold: free-milling gold (see above).

geochemical: of relation to various chemical processes as they operate under geologic conditions; often in reference to using the presence of specific chemical elements as indicators or pathfinders to the locations of economic mineral deposits.

geochemical anomaly: a target or "high" site or area encountered in the study of geochemical data (see definition of "geochemical", above).

granitic rock: rock that is primarily of the composition of granite, i.e. as much as 50% quartz and as much as 50% feldspar. The feldspar minerals are dominantly of the potash (or potassium-rich) variety, such as orthoclase or microcline, but lesser amounts of sodium-rich feldspar (plagioclase) can be present; ratios of potash feldspar to plagioclase are in the range of 9:1 to 2:1 (Jackson, 1970, p. 275). Mica and magnetite can be important trace components.

granodiorite: rock that falls largely within the mineral composition range of granite (see "granitic rock", above), but differs in the ratios of feldspars: potash to plagioclase is 2:1 to 1:2 (Jackson, 1970, p. 275).

hand-cobbing: a mineral beneficiating process in which mine product is sorted (and upgraded) by hand; a very expensive process.

heap leaching: part of a mineral beneficiating and recovery process in which mine product is placed in piles or "heaps" and then treated with some chemical reagent, usually acid, which percolates through the heaps and selectively removes the mineral commodity of interest, in solution form; the leachate is then collected and beneficiated further through other chemical processes, and treated to remove the mineral commodity from solution; usually applied to recovery of copper and gold; presence of the mineral commodity in native (elemental) or oxide form is important; not economically applicable for recovery of metals in sulfide form.

high-brightness marble: a highly pure form of marble that is of a particularly high unit value due to its lack of impurities (and absence of color); utilized in many industries, including paper, plastics, and ceramics manufacture.

host rocks: specific geologic materials in which a certain mineral deposit or variety of mineral deposit occurs.

hydrothermal alteration core: used in reference to copper-porphyry deposits or geologic environments in which copper-porphyry deposition is suspected; the most intense and usually central part of the alteration system that can form copper-porphyry deposits; the potassic zone of such copper-porphyry systems; an indicator of the location of some of the highest-grade hypogene (see below) copper that might be found in a copper-porphyry system.

hypogene: primary or initial location of deposition of a metal; used in reference to copper in copper-porphyry deposits.

igneous rock: rock deposited under specific conditions and locations: deep, subsurface, and in a molten or plastic state; many of the minerals within the rock formed via cooling and crystallization after the rock was in position, though late-stage fractionation and removal or certain rock-forming mineral crystals can occur in the cooling process.

industrial minerals: any rock or mineral of economic value, exclusive of metallic ores, mineral fuels, and gemstones; on of the non-metallics (A.G.I., 1980).

inferred resource: a mineral "resource" (see below) delineated with a rather high degree of uncertainty, such that "estimates are based on an assumed continuity beyond measured and (or) indicated resources, for which there is geologic evidence ... may or may not be supported by samples or measurements" (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 2); the category of mineral resource classification about which there is the most uncertainty or least accuracy in estimates.

in-situ leaching: a mineral beneficiation and recovery process such as that described under "heap leaching" (see above) with the exception that the deposit is exploited in-place and usually subsurface via drilling holes into the deposit, introducing a leaching solution, and pumping the pregnant leachate back out of the deposit through wells; applicable to copper mining.

intrusion/intrusive rock: the process by which igneous rocks (see above) are emplaced; an igneous rock.

Laramide time: a time in geologic history characterized by mountain building and introduction of many metallic mineral deposits in the National Forest; occurred on the border of the Cretaceous and Tertiary periods on the geologic time scale, or approximately 65 million to 70 million years ago.

leach pad: an important component of heap leaching (see above); an impervious layer designed to collect percolated, pregnant leachate and to prevent its loss into the environment and lower geologic strata or materials.

limestone: a sedimentary rock composed of calcium carbonate (see carbonate rocks definition, above).

lode: a mineral deposit located in the same place where it was initially formed through geologic processes; a contrasting term to "placer"; usually in reference to deposits in veins, faults, shears, and other planar and linear features.

metallic: composed of metals, such as copper, lead, zinc, gold, silver, molybdenum; the opposite of non-metallic (see industrial minerals definition, above).

metallized: geologic materials into which metals have been introduced through various geologic processes.

metallizing: geologic processes that introduce metals into geologic materials.

metamorphosed: rock that has been subjected to one or more of a variety geologic process in which geologic materials are chemically and mineralogically altered into new minerals, sometimes with new chemical compositions; usually operates via the mechanisms of heat and pressure.

mine: a site from which mineral commodities are removed from their natural place of origin; usually or hopefully done economically.

mineral: a general term; one of numerous naturally forming chemical compounds that form rocks, and may be of economic interest or use to mankind.

mineral commodities: a specific subset of the group of minerals (see above); implies economic interest or utility.

mineral deposit: in reference to mineral commodities, a natural occurrence of a useful mineral in sufficient extent and degree of concentration to invite exploitation (USBM, 1968); synonymous with the term "deposit" in this report.

mineral patent: private land awarded to the initial U.S. owner by the Federal government, based on the presence and discovery of a verified economic mineral deposit; process described in the Mining Law of 1872.

mining district: a group of mines and prospects in a somewhat loosely defined physical area, often with similar mineral commodities, occurrence types, host rocks, and age of formation.

monzonite: an igneous rock composed mainly of feldspars with the ratio of 2:1 to 1:2 potash feldspar to plagioclase (see definition of granitic rock for elaboration on feldspar) and less than 10% quartz (Jackson, 1970, p. 283).

non-metallic: in reference to mineral commodities that are of interest for mineral content that is other than that of metals (see definition of industrial minerals for elaboration).

opal: a form of quartz that can be precious or semi-precious, based on the degree and type of iridescence displayed by the specimen; in the National Forest, found in veins through volcanic rock.

open-pit mining: surface mining conducted in an open excavation or pit; in economic mineral deposits, implies a large-scale operation.

outcrop: natural exposure of geologic material, usually rock.

oxide ore: in reference to mineral commodities, the individual mineral units of which are bonded chiefly to oxygen, rather than sulfur; usually in reference to minerals that are desired and amenable for processes such as heap-leaching and in-situ leaching, as opposed to minerals that require the more expensive processes of flotation and smelting for metal recovery.

oxidized/oxide: in reference to mineral commodities having undergone formation of oxygen bonds or in the initial form of oxygen bonds; see "copper oxide" and "oxide ore" definitions for elaboration.

placer: a natural deposit of alluvial (see above) material; implies the presence of some mineral commodity interspersed within the alluvium, such as gold.

placer gold: gold located in or derived from a placer.

placer gold deposit: a placer (see above) containing gold in sufficient quantity and concentration to invite mining.

pluton: the rock mass resulting from an igneous intrusion (see above).

portland cement: a man-made product composed dominantly of the natural geologic materials limestone, sand, shale, and gypsum, and an iron source, and calcined in such a way to form clinker, which, when finely ground, will recrystallize and set when mixed with water.

Precambrian time: a block of geologic time used to define the Earth's history, beginning 570 million years ago, and continuing to the time of origin of the planet.

precious metal: gold, silver, platinum, or other members of the platinum-palladium group; the opposite of base metals.

prospect: a site in geologic materials, usually with an excavation, at which the accumulation or concentration of minerals has elicited economic interest; does not imply mineral production or profitability; also a small excavation made in the search for mineral commodities.

pyrite: a mineral composed of iron and sulfur; one of the chief "sulfide" (see below) minerals; an indicator of hydrothermal alteration and thus an important guide to finding concealed mineral deposits such as copper-porphyry deposits.

pyritization: one of the natural geologic processes through which pyrite (see above) is introduced into geologic materials.

quartz: a major rock-forming mineral composed of silicon and oxygen; chief component of sand.

quartz latite: an igneous rock of the same general composition as quartz monzonite (see definition, above), but with an aphanitic groundmass (i.e., composed of crystals too small to be seen through a hand lens); often a volcanic rock.

quartzose: containing the mineral quartz (silicon and oxygen) as a chief component.

Quaternary: the most recent division of time used to define Earth history; beginning 2 million years ago and continuing to current time.

replacement zone: an area, often of economically interesting mineral concentrations, formed through "the process of practically simultaneous capillary solution and deposition, by which a new mineral ... may grow in the body of an old mineral or mineral aggregate" (A.G.I., 1980).

reserve: in reference to a mineral deposit that "could be economically extracted or produced at the time of determination ... include only recoverable materials" (U.S. Bureau of mines and U.S. Geological Survey, 1980, p. 2).

resource: "a concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible." (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 1).

rhyolitic: of or near the composition of rhyolite, an aphanitic rock of the same composition of granitic rock (see above); rhyolites form through extrusive volcanism processes or shallow intrusion.

rip-rap: heavy, irregular rock chunks used to stabilize land from erosion, such as along stream banks and shorelines (USBM, 1968, p. 929).

rock-chip geochemical samples: the type of sample collected from mines and prospects during this USBM study of the National Forest; often collected to represent a cross section of a mineral-bearing zone; assayed for numerous elements and thereby extrapolated into an estimation of the types of metals present in a mineral-bearing zone and an approximation of the grades of those metals.

scheelite: a mineral containing tungsten; often an ore of tungsten.

sedimentary rocks: rocks formed by processes that take place largely on or very near the Earth's surface, including weathering, erosion, deposition by wind, water, or glaciers, compaction, solidification, burial, and lithification; a contrasting term with "igneous rocks".

shaft: a vertical or near vertical excavation into the subsurface; part of an underground mine (see below) that provides access.

shear zone: a specific type of fracture zone (see above) characterized by differential movement.

silica: a natural geologic material composed of quartz (silicon and oxygen); usually refers to an area in which the mineral has infiltrated large quantities of the existing rock or to a measurable geologic zone.

silicification: an alteration (see above) process by which additional silica is introduced into geologic materials; can be accompanied by deposition of economic metal deposits and is a good indicator when searching for such deposits.

skarn: a type of geologic material formed through various types of metamorphic and metasomatic processes in the Earth's crust as a result of the intrusion of metal-bearing igneous rocks into preexisting sedimentary rocks which are often carbonate in nature; can be an indicator that the processes responsible for the formation of copper-porphyry deposits have operated in the area.

smelting: a metal recovery process by which beneficiated mine products are fired and melted, after which sought-after metals are selectively removed in a molten state as impurities and gangue separate into a slag; chief method of recovering metals from sulfide ores.

stock: a generally small-size igneous rock intrusion (see definitions of batholith and pluton for comparison).

subeconomic resource: "that part of identified resources that does not meet economic criteria of reserves and marginal resources" (U.S. Bureau of Mines and U.S. Geological Survey, 1980, p. 2).

sulfide/sulfidic: containing and dominantly composed of minerals with bonds to sulfur; the initial form of most metallic mineral deposits.

sulfide minerals: one of a group of metallic minerals wherein the metals are chemically bonded to sulfur; chief among those in the National Forest are pyrite (iron), galena (lead), chalcopyrite (copper), and sphalerite (zinc).

sulfide ore: an economic concentration of sulfide minerals (see above).

supergene: secondary; a mineral accumulation formed through the secondary earth processes of weathering, percolation, and reconcentration on lower horizons; an important economic layer sought after in copper-porphyry deposits.

SX-EW: solvent extraction-electrowinning; a process by which the copper-bearing leachate from a heap leach or in-situ leach mine is beneficiated and the copper recovered through electroplating.

Tertiary-age: a period of geologic time used to define the Earth's history lasting from about 2 million years ago to about 75 million years ago; in Arizona, a time of major economic metal deposit formation.

underground mining: mining conducted in the subsurface and accessed through shafts or adits that open to the surface.

uraninite: a mineral containing uranium; often an ore of uranium.

vein: a zone of mineralized rock, usually planar in three dimensions, and distinctly separated from surrounding rock along boundaries; usually much larger in the length dimension that in the width dimension; frequently the site of metallic and some non-metallic mineral deposits and ore zones.

veinlet: a small vein; usually occur in groups as veinlet zones.

volcanic rocks: rocks formed by the natural process of volcanism; rocks often have the same compositions as igneous rocks, but have different textures that formed during the explosive and sometimes extrusive process of volcanism.

OPEN FILE REPORT MLA 23-94
PLATE 1

MINERAL APPRAISAL OF CORONADO NATIONAL FOREST, ARIZONA

Executive Summary

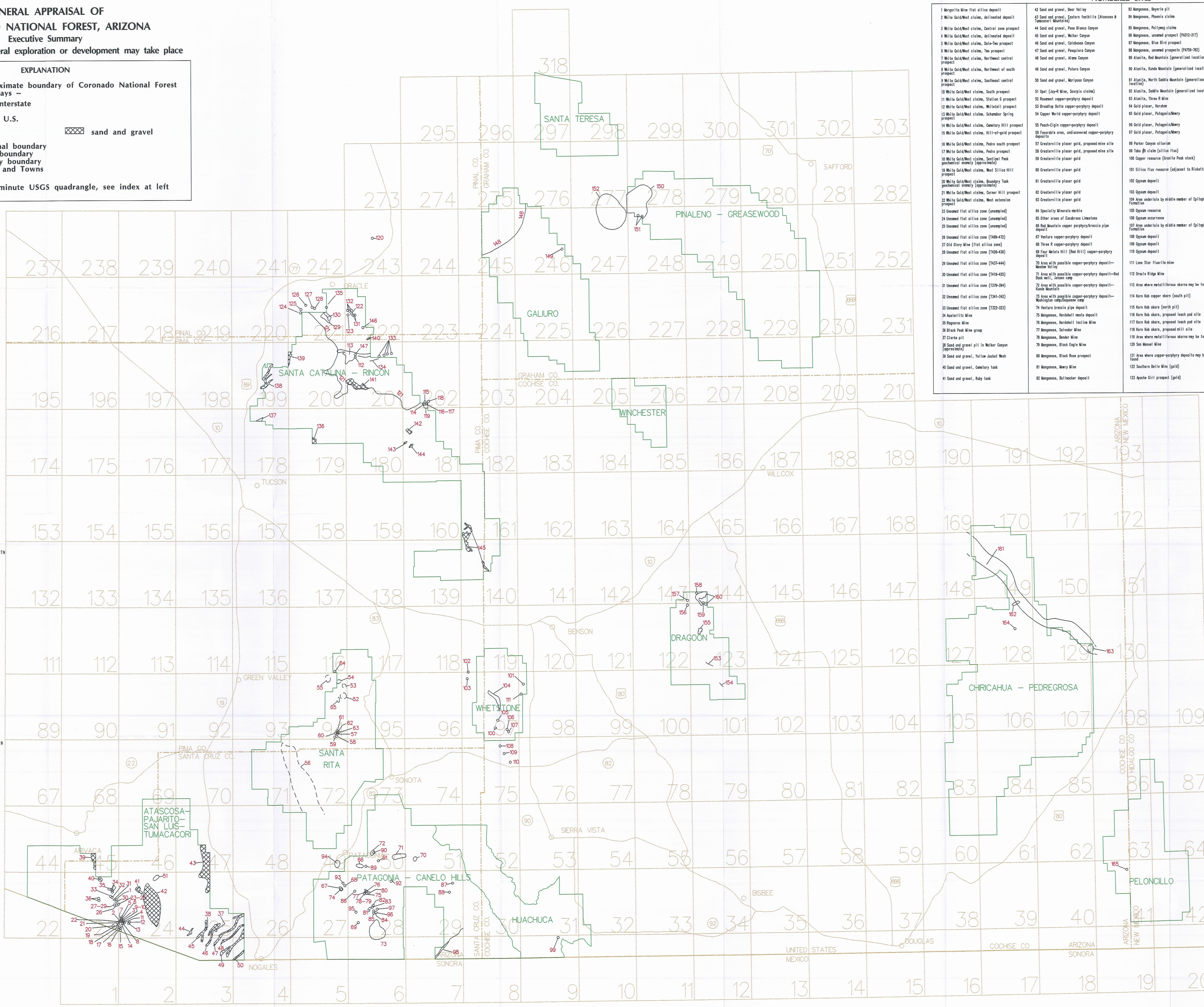
Sites where future mineral exploration or development may take place

EXPLANATION

- Approximate boundary of Coronado National Forest
- Highways –
  - 10 U.S. Interstate
  - 666 Other U.S.
  - 82 State
- National boundary
- State boundary
- County boundary
- Cities and Towns
- sand and gravel
- 31 7.5 minute USGS quadrangle, see index at left

7.5 Minute USGS Quadrangle Index

TIC-ID	USGS Quadrangle name	TIC-ID	USGS Quadrangle name
2	ALAMO SPRING	136	TUCSON SW
3	PAJARITO PEAK	137	TUCSON SE
4	NOGALES	138	VAIL
5	KINO SPRINGS	139	RINCON PEAK
6	DUQUESNE	140	GALLETA FLAT WEST
7	LOCHIEL	141	GALLETA FLAT EAST
8	CAMPINI MESA	142	SAN PEDRO RANCH
9	MONTEZUMA PASS	143	DRAGOON
10	BOB THOMPSON PEAK	144	COCHISE
11	STARK	145	SULPHUR SPRING
12	NACO	146	DOS CABEZAS SW
13	BISBEE	147	PAT HILLS NORTH
14	PAUL SPUR	148	BOWIE MTN. SOUTH
15	DOUGLAS	149	COCHISE HEAD
16	EAST OF DOUGLAS	150	BLUE MOUNTAIN
17	SAN BERNARDINO RANCH	151	SAN SIMON CIENEGA
18	WEST OF GUADALUPE CANYON	153	LA TORTUGA BUTTE
19	GUADALUPE CANYON	154	COCORAQUE BUTTE
20	GUADALUPE PASS	155	BROWN MOUNTAIN
22	CUMERO MOUNTAIN	156	CAT MOUNTAIN
23	BARTLETT MOUNTAIN	157	TUCSON
24	RUBY	158	TUCSON WEST
25	PENA BLANCA LAKE	159	TANQUE VERDE PEAK
26	RIO RICO	160	MICA MOUNTAIN
27	CUMERO CANYON	161	HAPPY VALLEY
28	HARSHAW	162	WILDHORSE MOUNTAIN
29	CANELO PASS	163	DEEPWELL RANCH
30	HUACHUCA PEAK	164	STEELE HILLS
31	MILLER PEAK	165	RED BIRD HILLS
32	NICKSVILLE	166	WILLCOX SOUTH
33	HEREFORD	167	SIMMONS PEAK
34	BISBEE	168	DOS CABEZAS
35	BISBEE NE	169	BOWIE MTN NORTH
36	DOUBLE ADOBE	170	LITTLE WOOD CANYON
37	DOUGLAS NE	171	VANAR NW
38	COLLEGE PEAKS	172	VANAR
39	CINDER HILL	174	WATERMAN PEAK
40	LAZY J RANCH	175	WEST OF ARVA
41	GUADALUPE SPRING	176	ARVA
42	BLACK POINT	177	JAYNES
44	WILBUR CANYON	178	TUCSON NORTH
45	ARIVACA	179	SABINO CANYON
46	MURPHY PEAK	180	AGUA CALIENTE HILL
47	TUBAC	181	PIETY HILL
48	SAN CAYETANO MTNS	182	SOZA CANYON
49	PATAGONIA	183	SOZA MESA
50	MT. HUGHES	184	HOOKERS HOT SPRINGS
51	O'DONNELL CANYON	185	MUSKHOG MTN.
52	PYEATT RANCH	186	SQUARE MOUNTAIN
53	FORT HUACHUCA	187	WILLCOX NORTH
54	LEWIS SPRINGS	188	RAILROAD PASS
55	TOMBSTONE SE	189	LUZENA
56	POTTER MTN.	190	BOWIE
57	GLEESON SE	191	OLGA
58	MCNEAL	192	SAN SIMON
59	LESLIE CANYON	193	DOUBTFUL CANYON
60	PEDREGOSA MOUNTAINS WEST	195	SILVER BELL EAST
61	PEDREGOSA MOUNTAINS EAST	196	WEST OF MARANA
62	PARAMORE CRATER	197	MARANA
63	SKELETON CANYON	198	RUELAS CANYON
64	CLANTON DRAW	199	ORO VALLEY
67	LAS GUIJAS	200	MOUNT LEMMON
68	CERRO COLORADO	201	MOUNT BIGELOW
69	SAUCITO MOUNTAIN	202	BUEHMAN CANYON
70	AMADO	203	REDINGTON
71	MT. HOPKINS	204	CHERRY SPRING PEAK
72	MT. WRIGHTSON	205	THE MESAS
73	SONOITA	206	REILEY PEAK
74	ELGIN	207	WEST OF GREASEWOOD MTN
75	MUSTANG MOUNTAINS	208	GREASEWOOD MOUNTAIN
76	HUACHUCA CITY	209	MONK DRAW
77	FAIRBANK	210	FISHER HILLS
78	TOMBSTONE	216	SAMANIEGO HILLS
79	HAY MOUNTAIN	217	RED ROCK
80	OUTLAW MOUNTAIN	218	DESERT PEAK
81	ELFRIDO	219	TORTOLITA MOUNTAINS
82	SWISSHELM MTN.	220	ORACLE JUNCTION
83	BRUNO PEAK	221	ORACLE
84	SWEDE PEAK	222	CAMPO BONITO
85	APACHE	223	PEPPERSAUCE WASH
86	SKULL CANYON	224	KIELBERG CANYON
87	MOUNT BALDY	225	BASSETT PEAK
89	FRESNO WASH	226	HARRISON CANYON
90	PENITAS HILLS	227	SIERRA BONITA RANCH
91	BATAMOTE HILLS	228	FORT GRANT
92	ESPERANZA MILL	229	STOCKTON PASS
93	GREEN VALLEY	230	GILLESPIE MOUNTAIN
94	HELVETIA	231	TONQUE
95	EMPIRE RANCH	237	NEWMAN PEAK
96	SPRING WATER CANYON	238	PICACHO PASS
97	APACHE PEAK	239	DURHAM HILLS
98	MCGREW SPRING	240	CHIEF BUTTE
99	LAND	241	FORTIFIED PEAK
100	HABERSTOCK HILL	242	NORTH OF ORACLE
101	BLACK DIAMOND PEAK	243	MAMMOTH
102	TURQOISE MTN.	244	CLARK RANCH
103	SQUARETOP HILLS WEST	245	RHODES PEAK
104	SQUARETOP HILLS EAST	246	KENNEDY PEAK
105	STANFORD CANYON	247	EUREKA RANCH
106	CHIRICAHUA PEAK	248	BLUE JAY PEAK
107	PORTAL PEAK	249	WEBB PEAK
108	RODEO	250	MT. GRAHAM
111	PALO ALTO RANCH	251	ARTESIA
112	STEVENS MTN.	252	ARTESIA NE
113	SAMANIEGA PEAK	273	LOOKOUT MOUNTAIN
114	TWIN BUTTES	274	HOLY JOE PEAK
115	SAHUARITA	275	OAK GROVE CANYON
116	CORONA DE TUCSON	276	KLONDYKE
117	MOUNT FAGAN	277	BUFORD HILL
118	THE NARROWS	278	TRIPP CANYON
119	MESCAL	279	SHINGLE HILL MOUNTAIN
120	BENSON	280	THATCHER
121	SAINT DAVID	281	SAFFORD
122	KNOB HILL	282	SAN JOSE
123	COCHISE STRONGHOLD	295	BRANDENBURG MTN.
124	PEARCE	296	BOOGER CANYON
125	SULPHUR HILLS	297	COBRE GRANDE MTN.
126	PAT HILLS SOUTH	298	JACKSON MTN.
127	FIFE PEAK	299	TELEGRAPH WASH
128	RUSTLER PARK	300	EDEN
129	PORTAL	301	PIMA
130	PORTAL NE	302	WEBER PEAK
132	SAN PEDRO	303	LONE STAR MTN.
133	THREE POINTS	318	MOUNT TURNBULL
134	SAN XAVIER MISSION SW		
135	SAN XAVIER MISSION		



NUMBERED SITES

1 Margarita Mine flat silica deposit
2 White Gold/West claims, delineated deposit
3 White Gold/West claims, Central zone prospect
4 White Gold/West claims, delineated deposit
5 White Gold/West claims, Dale-Two prospect
6 White Gold/West claims, Two prospect
7 White Gold/West claims, Northwest central prospect
8 White Gold/West claims, Northwest of south prospect
9 White Gold/West claims, Southeast central prospect
10 White Gold/West claims, South prospect
11 White Gold/West claims, Station G prospect
12 White Gold/West claims, Whitetail prospect
13 White Gold/West claims, Schumaker Spring prospect
14 White Gold/West claims, Cemetary Hill prospect
15 White Gold/West claims, Hill-of-gold prospect
16 White Gold/West claims, Pedro south prospect
17 White Gold/West claims, Pedro prospect
18 White Gold/West claims, Sentinel Peak geochemical anamaly (approximate)
19 White Gold/West claims, West Silica Hill prospect
20 White Gold/West claims, Boundary Tank geochemical anamaly (approximate)
21 White Gold/West claims, Corner Hill prospect
22 White Gold/West claims, West extension prospect
23 Unnamed flat silica zone (unsampled)
24 Unnamed flat silica zone (unsampled)
25 Unnamed flat silica zone (unsampled)
26 Unnamed flat silica zone (T469–472)
27 Old Glory Mine (flat silica zone)
28 Unnamed flat silica zone (T426–436)
29 Unnamed flat silica zone (T437–444)
30 Unnamed flat silica zone (T419–425)
31 Unnamed flat silica zone (T379–394)
32 Unnamed flat silica zone (T341–342)
33 Unnamed flat silica zone (T322–323)
34 Austerlitz Mine
35 Ragnaroc Mine
36 Black Peak Mine group
37 Clarke pit
38 Sand and gravel pit in Walker Canyon (approximate)
39 Sand and gravel, Yellow Jacket Wash
40 Sand and gravel, Cemetary tank
41 Sand and gravel, Ruby tank
42 Sand and gravel, Bear Valley
43 Sand and gravel, Eastern foothills (Atascosa & Tumacacori Mountains)
44 Sand and gravel, Pena Blanca Canyon
45 Sand and gravel, Walker Canyon
46 Sand and gravel, Calabasas Canyon
47 Sand and gravel, Pesquiera Canyon
48 Sand and gravel, Alamo Canyon
49 Sand and gravel, Potero Canyon
50 Sand and gravel, Mariposa Canyon
51 Opal (Jay-R Mine, Scorpio claims)
52 Rosemont copper-porphyry deposit
53 Broadtop Butte copper-porphyry deposit
54 Copper World copper-porphyry deposit
55 Peach-Elgin copper-porphyry deposit
56 Favorable area, undiscovered copper-porphyry deposits
57 Greaterville placer gold, proposed mine site
58 Greaterville placer gold, proposed mine site
59 Greaterville placer gold
60 Greaterville placer gold
61 Greaterville placer gold
62 Greaterville placer gold
63 Greaterville placer gold
64 Specialty Minerals marble
65 Other areas of Escabrosa Limestone
66 Red Mountain copper porphyry/breccia pipe deposit
67 Ventura copper-porphyry deposit
68 Three R copper-porphyry deposit
69 Four Metals Hill (Red Hill) copper-porphyry deposit
70 Area with possible copper-porphyry deposit—Meadow Valley
71 Area with possible copper-porphyry deposit—Red Bank well, Jensen camp
72 Area with possible copper-porphyry deposit—Kunde Mountain
73 Area with possible copper-porphyry deposit—Washington camp/Duquesne camp
74 Ventura breccia pipe deposit
75 Manganese, Hardshell manto deposit
76 Manganese, Hardshell Incline Mine
77 Manganese, Salvador Mine
78 Manganese, Bender Mine
79 Manganese, Black Eagle Mine
80 Manganese, Black Rose prospect
81 Manganese, Mowry Mine
82 Manganese, Bullwacker deposit
83 Manganese, Skyerie pit
84 Manganese, Phoenix claims
85 Manganese, Pollyweg claims
86 Manganese, unnamed prospect (PA312-317)
87 Manganese, Blue Bird prospect
88 Manganese, unnamed prospects (PA759-762)
89 Alunite, Red Mountain (generalized location)
90 Alunite, Kunde Mountain (generalized location)
91 Alunite, North Saddle Mountain (generalized location)
92 Alunite, Saddle Mountain (generalized location)
93 Alunite, Three R Mine
94 Gold placer, Harshaw
95 Gold placer, Patagonia/Mowry
96 Gold placer, Patagonia/Mowry
97 Gold placer, Patagonia/Mowry
98 Parker Canyon alluvium
99 Tako #9 claim (silica flux)
100 Copper resource (Granite Peak stock)
101 Silica flux resource (adjacent to Ricketts Mine)
102 Gypsum deposit
103 Gypsum deposit
104 Area underlain by middle member of Epitaph Formation
105 Gypsum resource
106 Gypsum occurrence
107 Area underlain by middle member of Epitaph Formation
108 Gypsum deposit
109 Gypsum deposit
110 Gypsum deposit
111 Lone Star fluorite mine
112 Oracle Ridge Mine
113 Area where metalliferous skarns may be found
114 Korn Kob copper skarn (south pit)
115 Korn Kob skarn (north pit)
116 Korn Kob skarn, proposed leach pad site
117 Korn Kob skarn, proposed leach pad site
118 Korn Kob skarn, proposed mill site
119 Area where metalliferous skarns may be found
120 San Manuel Mine
121 Area where copper-porphyry deposits may be found
122 Southern Belle Mine (gold)
123 Apache Girl prospect (gold)
124 Gold placer, Canada del Oro
125 Gold placer, Canada del Oro
126 Gold placer, Canada del Oro
127 Gold placer, Canada del Oro
128 Gold placer, Canada del Oro
129 Burney claims
130 Possible gold placer, Canada del Oro
131 Gold placers, Southern Belle Canyon
132 Gold placers, Bonito Canyon (generalized location)
133 Gold placer, Alder Canyon
134 Possible gold placer, Alder Canyon
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137 Sand, gravel, fill (Pima Canyon)
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139 Sand, gravel, fill (Sutherland Canyon)
140 Sand, gravel, fill (Stratton Canyon)
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142 Sand, gravel, fill (Government tank)
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145 Sand, gravel, fill (Happy Valley)
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159 Marble resource
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SCALE 1:250,000

2 0 2 4 6 8 10 mi

INDEX MAP

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